

RESEARCH IMPLEMENTATION REPORT 2007



ARIZONA TRANSPORTATION RESEARCH CENTER

MARCH 2008

Arizona Department of Transportation



Welcome

We conduct research to advance our knowledge of process, design or strategy. In order to advance our knowledge we have to make use of the information gained from performing research. In an effort to document the advancement of our knowledge through research the Arizona Transportation Research Center (ATRC) is publishing its sixth Research Implementation Report. This report reviews implementation that occurred during 2007 that resulted from ATRC research projects.



The process of preparing this report begins with collecting information about implementation from all potential users of ATRC research results. This information gathering can be both formal and informal. The formal process starts with ATRC research project managers sending the ATRC research implementation form to entities who participated in or had an interest in a study. The project managers then follow up with these contacts on a regular basis in an attempt to collect information about whether the research results were used, and if so, how. At the same time, information often flows into ATRC from a wide range of sources that reveals how research results are being used. Either way, the key to generating this information is the users providing feedback to ATRC.

The information gained through documenting implementation is a measure of the success of the research program. It also helps us improve the research program processes. With this in mind I thank everyone who helped provide information for this report.

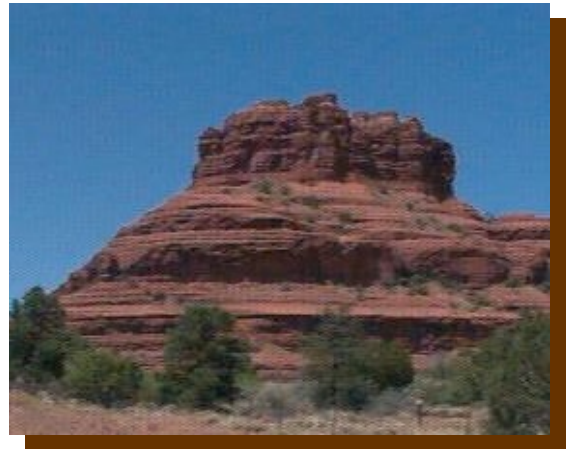
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About the Arizona Transportation Research Center

The Arizona Department of Transportation (ADOT) conducts research on a wide range of transportation topics. The Department's research effort is administered by the Arizona Transportation Research Center (ATRC), which has immediate responsibility for the management and conduct of research. During 2007 the ATRC research program was guided by the ADOT Research Council, which provided direction on research priorities.

The Arizona Transportation Research Center is located at 2739 East Washington Street, Phoenix, Arizona.



ATRC STAFF

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ATRC manages the ADOT transportation research program, coordinates the ADOT product evaluation program, houses and operates the ATRC Library, and provides direct financial support for ADOT's Local Technical Assistance Program (LTAP).

Each year ATRC solicits research proposals throughout ADOT and the transportation community. In meetings with individual offices or in Department-wide needs assessment meetings, ADOT personnel are asked to suggest research pertinent to their areas. ATRC also invites suggestions from academia, consultants, and industry.

Research suggestions are solicited through personal contact, newsletters, electronic communications, and the Internet.

The ATRC research program is currently grouped into seven emphasis areas. These areas are:

- Environment
- Intelligent Transportation Systems (ITS)
- Maintenance
- Materials and Construction
- Planning and Administration (including Motor Vehicles, and Information Technology)
- Structures
- Traffic and Safety



New projects are assigned to one of these areas. An ATRC project manager is assigned to each project. Technical advisory committees are formed for each project to work with the project manager on developing work scopes, reviewing and guiding the progress of the research, and reviewing the final report.

Small Budget Projects

The Arizona Transportation Research Center integrates opportunities for university students and small consulting firms into its research program. Each year ATRC allocates up to \$200,000 for small budget projects (\$25,000 or less) that often provide opportunities to contract university students and small consulting firms for transportation research. ATRC enthusiastically encourages future transportation professionals and small business. This strategy provides opportunities for individuals to learn first hand about the role of research and technology in the Nation's transportation system, and the variety of available transportation career or business options. The results have been high quality research that makes effective use of the ATRC research budget while providing valuable professional experience for students and small businesses.

Research Implementation

Implementation may range from assisting an entity in making a decision, to a change in operational strategies or activities. Implementation of research results often occurs over a period of several years. As such, implementation that occurred during 2007 will be addressed in this report, including actions associated with projects completed prior to 2007. The discussion is grouped by research emphasis area.

Implementation during 2007 affects highway design, construction and safety, transit development, environmental issues, and application of new technology. Research results included improvements in roundabout traffic interchange designs, road safety, developing effective applications of driving simulators, analyses of construction cost impacts, and wildlife road crossing studies.

Completed Projects

During calendar year 2007, eleven research projects were completed under ATRC management. *Appendix A* includes a list of these projects. All these projects are examples of applied research. As such, implementation of the research results is the ultimate measure of the success of the research.

Knowledge is not achieved until shared.

ENVIRONMENT



AZ-594: Use of Simulated Highway Underpass Crossing Structures by Flat-Tailed Horned Lizards

Project Cost

\$118,400

Summary

The propensity for flat-tailed horned lizards to use culverts as road crossing structures to avoid vehicle-caused mortality is unknown. From 2005-2006 we studied flat-tailed horned lizard use of a variety of simulated road crossing structures. The study objectives were to: (1) determine if flat-tailed horned lizards will pass through culverts of sizes commonly used in road construction, and (2) compare and describe the characteristics of culverts used by flat-tailed horned lizards to those not used.



A testing facility with six culverts of three dimensions and two interior lighting options was built. All culverts were 40 feet long; the three types included 24-inch diameter steel culverts, 36-inch diameter steel culverts, and 4-foot tall by 8-foot wide box culverts. Results indicated that flat-tailed horned lizards can use culverts as road crossing structures, but the evidence did not reveal a strong selection for or against any culvert type.

Implementation

The results of the simulated experiments were not conclusive enough to justify specific implementation recommendations in favor of a particular culvert design. Part of the recommendation is that additional studies looking at actual use of highway structures would be needed to establish effective structure design and extent of such structure utilization. The best option may be 36-inch diameter culverts. However, any large diameter culvert designs could work as crossing structures as long as: (1) fencing is used to funnel lizards or other animals toward the culvert, (2) the structure remains passable, (3) there is soil along the bottom of the passageway, and (4) the structure allows some daylight through its length.

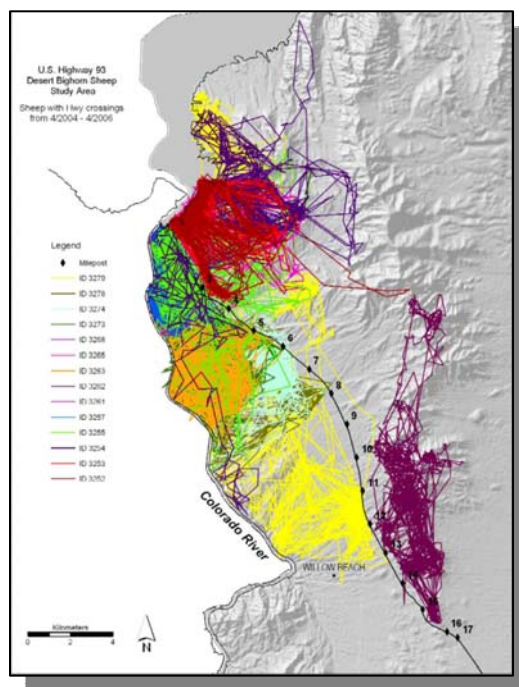
SPR-576: US-93 Bighorn Sheep Study: Distribution and Trans-Highway Movements of Desert Bighorn Sheep in Northwestern Arizona

Project Cost

\$185,000

Summary

Desert bighorn sheep were monitored *via* satellite telemetry, ground observations, and track beds between 2004 and 2006, primarily to determine distribution and movements relative to mileposts (MP) 3 to 17 of U.S. Highway 93 in the Black Mountains of northwestern Arizona. Bighorns concentrated trans-highway movements in the area of proposed highway realignments between MP 3 and 17 at five locations. The research team identified five continuous, linear, elevated ridgelines in this area where bighorns concentrated trans-highway movements. Eighty-two percent of highway crossings between MP 3 and 17 occurred near ridgelines at MP 3.3, 5.1, and 12.2. The research team concluded that highway crossing structures at these locations would promote highway permeability at a level ensuring genetic heterogeneity and vigor of the resident desert bighorn sheep population.



Distribution of collared bighorn sheep crossing SR93, 2004-2006

Implementation

The research was of direct relevance to the Environmental Planning and the Natural Resources Groups of ADOT. The work was coordinated with the Federal Highway Administration and other Federal, State, and local agencies—including the Forest Service, the Arizona Game and Fish Department (G&F), and the Bureau of Land Management. Efforts are on-going, working with the key G&F

project personnel to arrange for in-depth discussions between the outside parties involved in this project and relevant ADOT sections. The recommendations made in this report will be discussed. This will provide an opportunity to initiate steps towards developing future implementation guidelines for those items that are deemed feasible by the department. Otherwise, even in the absence of such guidelines, the results and recommendations presented in the report are available as references by project personnel on a project by project basis during project team deliberations and decision making.





SPR-585: *Snowplow Simulator Training Evaluation*

Project Cost

\$80,905

Summary

Driving-simulator safety training was initiated by ADOT in 2004 to improve winter maintenance operations by adding a significant new resource to optimize the program. Training was provided in December 2004 for 150 snowplow operators in five districts by L-3, a third-party vendor. Then, ADOT purchased its own L-3 simulator for the Globe District in mid-2005.

Arizona State University (ASU) was contracted to evaluate the initial training and results for two winters, in 2004-05 and 2005-06. The key tasks were to advise on procurement of ADOT simulator units, to assist with integrating the internal training program, and, to identify safety and economic benefits of this training. ASU completed an interim report on the regional training for 2004-05.

The research in 2005-06 focused on Globe District's new simulator unit and training program. ASU monitored snowplow driver training and results relative to accident and repair statistics for the 2005-06 winter season for Globe, as well as statewide. Data collection was completed in August, and ASU's final report was printed in January 2007. No obvious trends were measurable on this small scale, but along with a series of

suggestions on enhancing the training program, the project team also recommended a further, more focused study in several key cost areas.

Implementation

Based on key project SPR-585 recommendations, a new study was initiated for 2006-07. Project SPR-635 would clarify simulator training program costs and benefits with additional field data from another winter, and support future evaluations of two new simulators assigned to other districts. Globe District, the pilot project site, completed a new driving skills training course in early 2006 for all 60 of its snowplow operators, allowing for a more detailed study of long-term repairs and fuel usage.



ATRC project SPR-635 with ASU (2006-07) was a key implementation outcome. This focused field evaluation of quantifiable measures of cost reductions in fuel and repair costs in the Globe District showed real-world fuel savings on manual-transmission trucks in a series of long-distance fuel test runs monitored by ASU in mid-2007.

Also as recommended by project SPR-585, a Simulator Working Group was created for the three districts with simulators in mid-2006 to coordinate their efforts and to standardize the training curriculum while still incorporating local practices and concerns. ATRC's implementation support to the Intermodal Transportation Division Technical Training Group has included reports, conference presentations, and coordination. A key role in 2007 was to support and advise the Simulator Working Group.

Very significant budget and human resource constraints remain, including adequate facilities for the training, either mobile or classroom, and adequate and timely support to the local volunteer trainers. However, ADOT has committed to equip and staff a total of five district simulator training operations by mid-2008, either housed in district offices, or in mobile classroom trailers.

Other challenges remain: support by district managers at several key levels may be inconsistent, and retention of the local-level volunteer trainers will require major time and resource commitments. However, as also recommended by project SPR-585, the leadership of the Working Group was finally resolved in early 2008 with senior management commitments for sponsorship and participation.

SPR-569: Transportation Communications Interoperability Phase 2- Resource Evaluation

Project Cost

\$149,788 – Federal Highway Administration State Planning & Research funds

\$50,981 – Homeland Security funds

Summary

This project carried out two field communications interoperability pilot projects based on a prior radio communications Needs Assessment study (ATRC project SPR-561, August 2004), which identified shortfalls in mobile radio and dispatch center communications for ADOT and Arizona Department of Public Safety (DPS) joint operations under the current state radio system. A key issue was the lack of direct radio communication in the field, as ADOT and DPS operate on different radio frequencies.



This project had both a design phase to establish the pilot project basis, and a deployment and evaluation phase. Meetings with field users helped to complete the project design and evaluation plan. Specific enhancements included providing ADOT radios to DPS vehicles in selected areas, and upgrades to statewide dispatch radios at central DPS and ADOT facilities. To expand the test scope, additional mobile radios were funded by a Homeland Security grant.

By mid-2006, all project equipment was procured and field training was initiated. Users in both departments were asked to document all uses of direct communications for roadway incident management and other joint operations, as were the emergency dispatchers also. The added mobile radio units for DPS enabled field interoperability tests to continue through October 2006. The research activity and analysis ended in November 2006, but all communications equipment remains in long-term service. The Final Report was published in March 2007.

Implementation

The primary recommendation was for implementation of ADOT-compatible field radios for all rural DPS patrol cars, along with improved dispatch console technology. Project sponsors presented the results to ADOT and DPS senior staff in April 2007. Steps were taken in June 2007 to complete the console upgrades for ADOT and DPS in

Phoenix, as one successful outcome of the project. However, funding for several hundred additional radios in DPS vehicles is currently not available.

The consultant provided updated training materials in closing out the project, in early 2007. This allowed the field users to provide training to new hires in the most successful aspects of the joint communications resources.

Feedback was obtained in late 2007 that some DPS/ADOT field radios were not always being monitored for ADOT activity during joint incident operations. ADOT district staffs were advised to discuss this issue at the local-partner level. In early 2008, DPS confirmed that they were using the training materials for dispatch operators, and requested additional copies.





SPR-622: Price Trends for Major Roadway Inputs

Project Cost

\$0 [project completed by ATRC staff]

Summary

Fluctuations in construction costs make the tasks of estimating the price of a project and the overall highway program difficult. The objective of this research project was to examine the price fluctuations of the most heavily used construction commodities over both the short and long terms. An index for each of these commodities has been created.

Implementation

The implementation plan for this project is to generate a monthly update of these indices and distribute it to personnel charged with estimating future construction costs for projects and budgeting the highway construction and maintenance programs. These monthly updates have been prepared by ATRC staff since January 2007. (See: http://www.azdot.gov/TPD/ATRC/Publications/Price_Trends/index.asp)

SPR-579: Making a Good First Impression: Improving PreDesign and Environmental Public Information

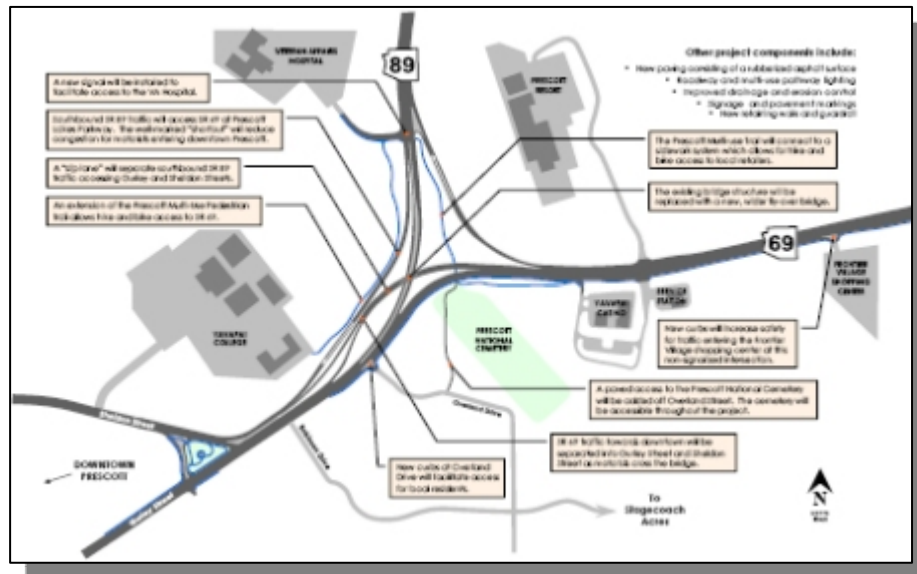
Project Cost

\$15,000

Summary

From project scoping through ADOT's initial investigations into project viability, the public receives its first opportunity to review and comment upon potential projects. This exposure forms a first impression of ADOT's professionalism, its accountability toward accepting desired design concepts, and setting an appropriate standard for final design and, ultimately, construction. Suggestions were made for a more refined and consistent approach for seeking public involvement and for positioning ADOT as an accountable

professional services provider, dedicated to bettering Arizona's transportation systems and its citizens' quality of life through extensive public information and community relations programs.



Implementation

All of the research recommendations were accepted for implementation. ADOT's Communication and Community Partnerships (CCP) section is currently taking action to achieve the following results:

- (1) Working with project teams to budget for public involvement and public information expenses,
- (2) A Valley Freeways web portal has been put to use for the public to learn and become involved in ADOT projects,
- (3) CCP has established a formal partnering process with Navajo and Hopi tribes to better relationships,
- (4) CCP has established a foundation to create performance measures,
- (5) CCP public involvement staff to has taken 3-day National Environmental Policy Act training through coordination with FHWA,
- (6) CCP has requested research aimed at developing performance standards (ATRC project SPR-655), and
- (7) CCP has expanded staff to better handle communications with the public.



SPR-629: Analysis of Capacity and Operations after Retrofit Improvements of Happy Valley and I-17 Roundabout Traffic Interchange

Project Cost

\$80,000

Summary

This study focused on assessing the effectiveness of the improvements to twin single lane roundabouts. The most significant change was retrofitting the single lanes in each roundabout to a dual lane circulating roundabouts. This change was completed in 2005. The conclusions reached were:

- (1) The average speeds for which vehicles enter or exit the roundabouts are the same for both dual and single lanes, which are 20 mph on entering and 30 mph when exiting.
- (2) Observed driver behavior for maneuvering through the roundabouts was the same before and after the retrofit.
- (3) Crash rates increased after the retrofit were due primarily to an increase in sideswipe incidents caused by vehicles leaving their lane when exiting roundabouts.
- (4) The severity rates were lower at the roundabouts than at two nearby signalized traffic interchanges with similar geometry, i.e., frontage roads and dual lanes.

The outcome of this research project was to give a general understanding of the operation and capacity of a dual lane roundabout in Arizona.

Implementation

Implementation included modifying the exit geometry of the dual lane roundabout to flatten the reverse curvature at exit paths. By doing so, the intent is to minimize the number of vehicles leaving their lane upon exiting the roundabout. In addition, landscaping that was blocking existing signage was removed for better visibility to maximize the driver's initial lane choice when entering the roundabout and minimize weaving through the roundabouts.



TRQS-04: Data Collection Software Used by Law Enforcement Agencies in Arizona

Project Cost

\$5,000 – Federal Highway Administration State Planning & Research funds
\$25,000 – other funding sources

Summary

This study sought a cost-effective solution for ADOT to efficiently process approximately 135,000 crashes reported annually by local law enforcement agencies. The conclusions reached were:

- (1) Of the 60 survey respondents representing 45 law enforcement agencies in Arizona, 25 unique software systems were being used to store crash data.
- (2) Over half of the agencies surveyed were willing to try a new software system if provided to them at little or no cost.
- (3) Six data collection systems were analyzed in-depth from the pool of 30+ systems used nationally.
- (4) Two systems, TraCS and APS, ranked the highest in meeting the business requirements for Arizona's law enforcement agencies.

The outcome of this research project was presented to the Traffic Records Coordinating Committee (TRCC) in Arizona on September 18, 2007.

Implementation

Implementation included providing the TRCC and other decision-makers the research results for their consideration in purchasing a crash data collection software system that would process and store crash data more efficiently than current methods used at the local and state level. Deployment of TraCS and new crash data collection processes is currently underway with full implementation expected in 2009.

Data Collection Systems Evaluated in System Alternatives		
New World Systems (AEGIS)	TADS	LEADRS
TraCS	Sleuth RMS	PDEP
BARD	Priors	DART
CHIPS	ICIS	Microsoft Word
PSSI	SIRE	Oracle
DaProSystems	Spillman (Summit)	Millennium
Personnel Deployment Systems	Report Beam	psNET
ADSi	Intergraph Public Safety (ILEADS)	AthenaRMS
Advanced Public Safety (APS)	Quicksene	TIES
SafetyNet	CODY	Sun Ridge Systems
Map Scenes	RMS	VisionTEK
HTE (Sunguard)	Crimestar	Visual Statements



Appendix A

List of Projects Completed During 2007

Project No.	Project Title
SPR-569	<i>Transportation Communications Interoperability Phase 2- Resource Evaluation</i>
SPR-576	<i>US-93 Bighorn Sheep Study</i>
SPR-579	<i>Making a Good First Impression: Improving PreDesign and Environmental Public Information</i>
SPR-585	<i>Snowplow Simulator Training Evaluation</i>
AZ-594	<i>Flat-Tailed Horned Lizard Highway Crossing Study</i>
SPR-595	<i>Real-time Adaptive Ramp Metering: Phase 1 - Simulation & Proof of Concept</i>
SPR-615	<i>ITS Concepts for Rural Corridor Operations</i>
SPR-620	<i>Developing a Stabilized Public Transportation Revenue Source</i>
SPR-621	<i>High Density Polyethylene Pipe Fill Height Table</i>
SPR-629	<i>Analysis of Capacity and Operations after Retrofit Improvements of Happy Valley and I-17 Roundabout Traffic Interchange</i>
TRQS-04	<i>Data Collection Software Used by Law Enforcement Agencies in Arizona</i>

Research: The relentless pursuit of excellence.

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